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EXAMINER

FOURSON III, GEORGE R

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte PAI HUNG PAN

Appeal 2008-005294
Application 09/072,959
Technology Center 2800

Decided: August 24, 2009

Before ALLEN R. MacDONALD, *Vice Chief Administrative Patent Judge*,
and KAREN M. HASTINGS, and MICHAEL P. COLAIANNI,
Administrative Patent Judges.

COLAIANNI, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellant seeks review under 35 U.S.C. § 134 from the Examiner's rejections of claims 1-5, 11-17, 25-28, and 33-38 in the Final Office Action. This Board has jurisdiction under 35 U.S.C. § 6(b). We AFFIRM.

STATEMENT OF THE CASE

The invention of the present invention is directed to a method of forming a shallow trench isolation structure for a semiconductor device (Spec. 1).

Claim 1 is illustrative:

1. A method of forming an isolation structure for a semiconductor device, comprising:

providing a layered structure comprising a semiconductor substrate, a dielectric layer, and a buffer film layer;

etching said layered structure through said buffer layer, through said dielectric layer; and

into said semiconductor substrate to define a trench having sidewalls and a bottom; forming an oxide layer on exposed portions of said semiconductor substrate within said trench; selectively etching a portion of said buffer film layer after the oxide layer has been formed; applying a layer of isolation material over said buffer film layer and filling said trench; removing a portion of said isolation material layer above said buffer film layer; and removing said buffer film layer.

The Examiner cites and relies upon the following prior art as evidence of obviousness:

Lancaster	US 4,835,584	May 30, 1989
Tsai	US 5,712,185	Jan. 27, 1998

Lee, H.S., *An Optimized Densification of the Filled Oxide for Quarter Micron Shallow Trench Isolation (STI)*, IEEE Symposium on VLSI Technology Digest of Technical Papers, 158-59 (1996).

The Examiner maintains the following rejections of the pending claims:

1. Claims 1-4, 11-14, 16, 25-27, 33-35, and 37 stand rejected under 35 U.S.C. § 103(a) as obvious over Tsai in view of Lancaster.
2. Claims 17 and 38 are rejected under 35 U.S.C. § 103(a) as obvious over Tsai in view Lancaster and the Examiner's explanation on page 4 of the Answer.
3. Claims 5, 15, 28, and 36 are rejected under 35 U.S.C. § 103(a) as obvious over Tsai in view of Lancaster and Lee.

With regard to rejection (1), Appellant argues the claims as a group (App. Br. 10-12). We select claim 1 as representative of the group.

With regard to rejections (2) and (3) of dependent claims, Appellant advances no further arguments (App. Br. 12-13). Rather, Appellant argues that the rejected dependent claims are allowable for the same reasons the independent claims were argued to be allowable (i.e., the same arguments made regarding claim 1) (App. Br. 12-13). Accordingly, rejections (2) and (3) stand or fall with our analysis of claim 1 of rejection (1).

ISSUE

Has Appellant shown reversible error in the Examiner's determination that one of ordinary skill in the art would have modified Tsai's process for forming isolation structures by lining the trench with a sacrificial oxide layer prior to etching the buffer layer (i.e., silicon nitride layer) as required by claim 1 to prevent damaging the walls of the trench as taught by Lancaster? We decide this issue in the negative.

PRINCIPLES OF LAW

“The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

The test for obviousness is not whether the features of one reference may be bodily incorporated into another reference. *In re Bozek*, 416 F.2d 1385, 1390 (CCPA 1969). Rather, we look to see whether the combined *teachings* would have rendered the claimed subject matter obvious. *Id.* *See also, In re Keller*, 642 F.2d 413, 425 (CCPA 1981) (“[T]he test [for obviousness] is what the combined teachings of the references would have suggested to those of ordinary skill in the art.”).

A reference that teaches away cannot serve to create a *prima facie* case of obviousness. *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994). A reference may be said to teach away “when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.” *Id.* The degree of teaching away will of course depend on the particular facts; in general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant. *Id.*

FINDINGS OF FACT (FF)

The following facts are supported by a preponderance of evidence in the record.

1. Appellant does not dispute that the combination of Tsai and Lancaster teaches all the features of claim 1 (App. Br. 10-12).

2. The Examiner finds that Tsai teaches etching the silicon nitride (i.e., buffer layer) (34A/34B) before forming an oxide layer (39) on the walls of the trench (38/38A) (col. 3, ll. 19-40; Figs. 3D-3F).
3. Tsai teaches etching the silicon nitride layer with a phosphoric acid solution (col. 3, ll. 19-22).
4. Lancaster teaches forming trenches in a semiconductor substrate and protecting the walls of the trench (56) from the phosphoric acid solution used to etch the silicon nitride layer (53) with a sacrificial oxide layer (52a) prior to etching (col. 3, ll. 40-45; Figs. 5D and 5E). The sacrificial oxide layer 52a and pad oxide remain after the silicon nitride is fully etched (Fig. 5D and 5E).

ANALYSIS

Appellant argues that there is no motivation to modify Tsai's process to coat the trench walls prior to etching the silicon nitride because Tsai did not consider precoating the trench walls as an option at the time of Tsai's invention (App. Br. 10-11). In other words, Appellant argues that if precoating the trench would have been obvious, then Tsai would have taught precoating the trench prior to silicon nitride etching. However, Appellant's argument is directed at whether Tsai anticipates the claim, and fails to address the Examiner's reason for determining that it would have been obvious to modify Tsai's process in light of Lancaster's disclosure.

Appellant further argues that there is no reason to modify the trenches of Tsai's process, which selectively removes portions of the silicon nitride and forms an oxide layer on the trench walls post-silicon nitride removal to cure any defects formed by the etching step on the trench walls, to have

Lancaster's oxide coating used to protect the trenches from Lancaster's etching step that removes the entire silicon nitride layer (App. Br. 11). In that regard, Appellant contends that Tsai's post-silicon nitride oxidation step cures any defects produced by the descuming (i.e., etching step) such that there would be no reason to form an oxide layer before the descuming (i.e., etching process) in Tsai (App. Br. 11). Appellant further contends that Lancaster's more aggressive etching step that completely removes the silicon nitride layer teaches away from the combination with Tsai's process that uses a selective etching step to leave a portion of the silicon nitride layer as an end point detecting layer (App. Br. 11).

Appellant contends that applying Lancaster's teachings to "the process of Tsai would also require that any oxide on the surfaces of the trench of Tsai be removed, which would also remove material from the pad oxide layer 32A of Tsai" such that there would have been no reason to expect that combining Tsai's and Lancaster's teaching would have been successful (Reply Br. 4). Stated differently, Appellant contends that since Lancaster appears to disclose removing the sacrificial oxide layer 52a that lines the trenches and the pad oxide layer 52 after the silicon nitride film is etched (*Compare* Fig. 5D, 5E and 5F), the Examiner's combination would require such removal too, which is contrary to Tsai's teaching that a portion of the pad oxide layer remains.

Appellant's arguments are unpersuasive because the test for obviousness is not whether the features of one reference may be bodily incorporated into another reference as argued. *Bozek*, 416 F.2d at 1390. The Examiner's rejection does not propose modifying Tsai's process to use Lancaster's step of complete etching and removal of the silicon nitride layer

or the post-silicon nitride etching step to remove the pad oxide 52 and sacrificial oxide 52a. Rather, the Examiner's rejection proposes to modify Tsai's process by forming an oxide layer on the trench prior to etching the silicon nitride layer in order to protect the wall of the trench as taught by Lancaster (FF 4 and Ans. 4). Appellant's arguments fail to address this particular reason provided by the Examiner.

Likewise, Appellant's arguments that there is no reason for combining Lancaster and Tsai are unpersuasive because they fail to show error in the particular reason provided by the Examiner for modifying Tsai's process to include Lancaster's oxide coating prior to etching the silicon nitride layer: preventing damage to the trench. Indeed, preventing damage to the trench by forming an oxidation coating prior to etching the silicon nitride would have avoided the necessity of Tsai's post-etching oxidation to fix defects caused by etching that Appellant contends are caused by Tsai's process. In other words, it would have been obvious to modify Tsai's process to include Lancaster's oxidation coating step of the trenches prior to silicon nitride etching because such a modification does no more than yield predictable results: protection of the trench during etching. *KSR*, 550 U.S. at 416.

Regarding Appellant's teaching away argument, neither Lancaster nor Tsai discourages using an oxide coating on the walls of the trenches. *Gurley*, 27 F.3d at 553. To the contrary, Lancaster expressly teaches that using an oxide coating on the walls of the trenches to prevent damage thereto (FF 4). That Tsai uses a selective etching process does not discourage protecting the walls of the trench during etching. Indeed, both Tsai and Lancaster use a phosphoric acid solution to etch the silicon nitride layer (FF 3 and 4), such that one of ordinary skill in the art would have

expected that coating Tsai's trench walls with an oxide would have successfully prevented the phosphoric acid from damaging them as taught by Lancaster. Instead of teaching away, the references, in fact, would have suggested using the oxide protective coating prior to etching of the silicon nitride layer to prevent damage to the trench walls. Because the references suggest the modification, Appellant's impermissible hindsight argument is also without persuasive merit.

ORDER

We AFFIRM all of the Examiner's § 103 rejections.

TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1).

AFFIRMED

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